# $SrRuO_3$ Perovskite Based Compounds for Supercapacitors: Synthesis, Structure, and Electrochemical Performance

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Among the oxide materials for application in supercapacitors ruthenium oxides have achieved much attention [1-4], due to their high pseudocapacitance. Up to 500 F/g [5] or 720 F/g [6] are reported for amorphous water containing ruthenium oxides.

Ruthenates based on perovskite structure of the general formula $ABO_3$ containing ruthenium on the B position have been shown to exhibit pseudocapacitance behavior [7-8]. These materials also show metallic conductivity and are stable in aqueous alkaline electrolytes. Ruthenates with perovskite type structure offer a wide field for chemical modification by modifying the A and B site with foreign metals. The specific capacity as well as the stability window are strongly affected by dopands. Replacing up to 20 mole% strontium by lanthanum leads to an increase of the specific capacity and an extension of stability window about 0.1 V. On the other hand iron or cobalt substitution on the B-site reduces the stability range and has no beneficial effect on capacity, whereas doping by manganese increases the capacity without affecting the stability.

The aim of the work is increasing the capacity and reducing the amount of ruthenium by

- Increase of proton mobility in the perovskite structure
- Creating more additional free structure volume for the transport of counter ions during charge and discharge
- Increase of capacity by increasing $Ru^{3+}$ content
- Built in of other redox components
- Increase of surface by preparation process

Therefore we have prepared a family of manganese mixed doped perovskites $La_xSr_{1-x}Ru_{1-y}Mn_yO_3$. These materials are formed by using a direct pyrolysis route. The precursor is an aqueous solution of ruthenium chloride, metal nitrates and strontium nitrate well in excess. This solution is pyrolysed at temperatures about 500 – 750 °C. The samples usually contain the desired perovskite and large amounts of water soluble strontium chloride and its hydrates. After removing these phases by washing with distilled water very porous samples of perovskites are obtained. The pseudocapacitance can be increased by doping up to about 20 % of lanthanum and manganese. Higher amounts of dopands leads to phase separation and decreased stability window. More detailed results concerning synthesis conditions, structure and electrochemical behavior of mixed doped strontium ruthenates will be presented.

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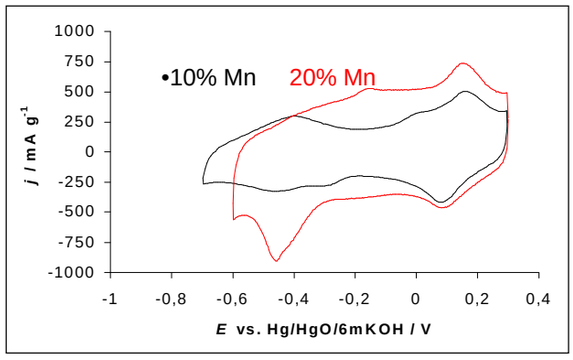


Figure 1: Cyclic voltammogramm of two manganese doped strontium ruthenates $SrRu_{1-x}Mn_xO_3$ with x = 0,1; 0,2, scan rate 20 mV/s

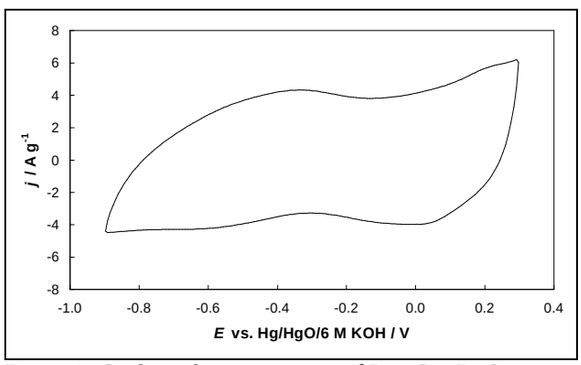


Figure 2: Cyclic voltammogramm of $La_{0.2}Sr_{0.8}RuO_3$, scan rate 20 mV/s